## A SHORTENING OF THE METHOD OF MAKING INTERCENSAL ESTIMATES OF POPULATION.

In the course of a university lecture on an economic subject the following method was recently recommended for computing the population of a city in 1909, when the population figures for 1900 and 1905 are known: Take the ratio of increase between 1900 and 1905, and multiply the population in 1905 by four-fifths of that rate. This obviously amounts not to "assuming a constant rate of increase," but to assuming a constant geometrical progression between the censuses, and for intercensal points an arithmetical ratio. In other words, in terms of the graphic method, intermediate points are taken on the chords of the curve rather than on the curve itself. The *consistent* method of computing intercensal estimates on the basis of a constant rate is so simple, and its employment in correcting estimates, after the results of the approaching census are published, is likely to be so common, that the following method, used by the writer in computing a large number of intercensal populations, is given in the hope that it may prove useful:—

The common problem is this: Given the population of a community in 1900 and 1905, on a certain month and day, to find the population for the middle of the year (on which most rates are computed) for some year between the two, or for some year between 1905 and 1910. Suppose, for example, the population on July 1 (middle of year), 1907, is required. Proceed as follows: take the logarithms of the population in 1900 (log P) and in 1905 (log P'), subtract them, multiply the difference by 25/60 (because, assuming the 1900 and 1905 censuses, as usual, speak for June 1, there are 60 months from 1900 to 1905 and 25 months from June 1, 1905, to July 1, 1907), and add this product to the logarithm of the 1905 population, then take the antilogarithm of that result, which is the required population. The work of multiplying a number by 25/60 may be set down as follows: to multiply, say, 16764 by 25/60,—

$$
\begin{array}{r}
6)16764 \\
\hline
4 \\
2794 \\
67056 \\
\hline
6985.0
\end{array}
$$

This abbreviated method amounts, it will readily be seen, to putting the fraction 25/60 in the form $\frac{41/6}{10}$ and performing the indicated oper-

ation. When a multiplying machine is not available and a slide-rule will not give results accurate enough (as it frequently will not, especially when the estimates must check and agree as to totals), this short method saves considerable time. As most intercensal periods are five years, or 60 months, the denominator would usually be 60. It can be employed to advantage where it is desired to multiply by any fraction of the form $\frac{ab+1}{10b}$, where $a$ and $b$ are integers less than 10. A fraction can therefore be readily tested as to whether multiplying by it can be so shortened by subtracting one from the numerator, and noting whether the result is divisible exactly by the denominator divided by 10. This process is also useful where arithmetical estimates, rather than geometrical, are made, the only difference being that numbers are used instead of their logarithms.

In view of the confusion existing among many investigators of problems requiring statistical treatment, as to a correct and easy method for making population estimates, it seemed desirable to give the above.

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